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# Versatility of the humble seaweed in biomanufacturing

Jae-Llane Ditchburn and Carlos Brais Carballeira

4-5 October (2018)

Tirgu Mures, Romania

The 12th International Conference Interdisciplinarity in Engineering

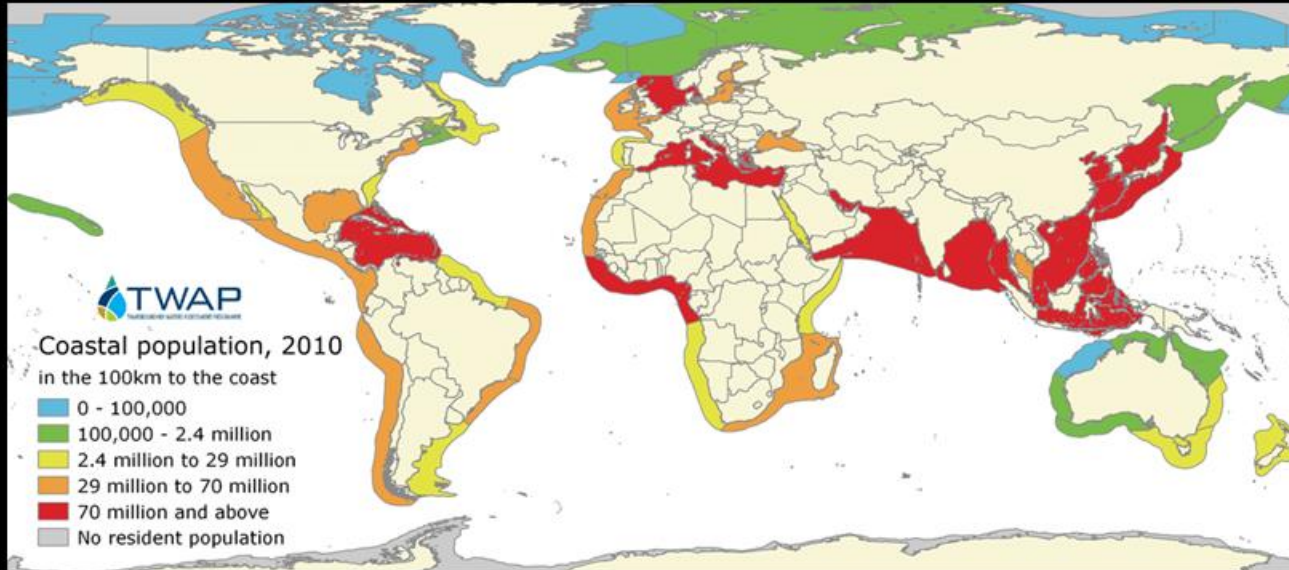


# Seaweed

- Types: Green, Brown and Red
- Diverse biological characteristics
- May grow in diverse environments



# Sustainability



- More than half of population lives at the coast (<100 km)
- 71% of world surface belongs to the oceans
- Macroalgae cultures bioremediate organic contamination
- Macroalgae may be later used to produce biofuels, bioplastics, food, medicines...





# Uses in biomanufacturing

- FOOD
- ENERGY
- HEALTH
- MATERIALS

## Direct use of a seaweed

Bioremediation

Bioindication

Aquaculture

Fertilizer and soil  
conditioners

Animal  
feed

## Biological and chemical transformation

Medicines and  
pharmaceuticals

Cosmetic  
industry

Food and  
edible items

## Bioengineering

Biofuels

Bioenergy

Bioplastics

Bionanotechnology

# Byproducts

## ENVIRONMENT

- Fertilizers
- Soil conditioners
- Aquaculture

*Eutrophication control*  
*Antifungal*  
*Water footprint*  
*Climate change*

## NUTRITION

*Antioxidant*  
*Nutritional benefits*  
*Healthcare*  
*Immunity enhancement*

- Food supplements
- Feed aditives
- Animal
- Cosmetics

### Extracts from Seaweed

Polysaccharides  
Proteins  
Polyphenols  
Pigments  
Conjugated fatty acids

- Medicines
- Biomedical parts

## MEDICINE

*Antimicrobial*  
*Antiviral*  
*Anti-inflammatory*  
*Anticoagulant*  
*Anticancer*  
*Anti-allergy*

## FUELS & BIO-MATERIALS

- Bio-crude
- Bio-char
- Bio-gas
- Bio-plastics
- Bio-nanoparticles

*Renewable energy*  
*Eco-friendly fuels*  
*Biodegradable waste*

# Bioplastics



- Similar characteristics to those obtained from crude (properties and fabrication)
- Biodegradable and renewability (Environmentally friendlier)
- No toxicity at human feeding activities neither implantable materials
- More resistant to microwave radiation, less brittle and durable
- PHA and PHB are green substitutes of polypropylene







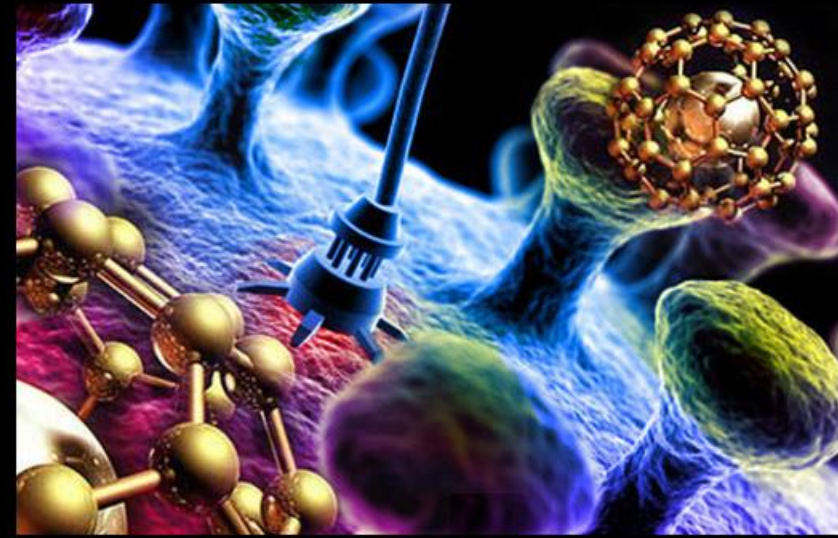
# Biofuels

- Advantages compared to terrestrial plants
  - efficiency on photosynthesis
  - no competition for habitat
  - reduction in eutrophication and toxicity
  - easier production
  - higher methanogenic potential and EROI (energy return of investment)
- Bio-crude and bio-chars with high energy output
- Energy produced by direct combustion is more efficient than coal power plant



# Bionanotechnology

- Mediation of synthesis of metal Nanoparticles
- Metal nanoparticles (Ag, Au, Fe and Pt)
- Metal oxide nanoparticles (Cu, Zn and Fe oxides)
- Biosynthesis is still not well understood





# Conclusions

- Accelerated growth, regeneration and easy cultivation
- Address global environmental issues and avoid competition with other land activities
- Numerous natural properties and bioactive compounds
  - Treat cancer
  - Power engines
  - Biodegradable plastics
  - ...
- However, further research on biomanufacturing processes is needed to develop competitive, healthy and more sustainable methods



Thank you!